Why Innovations of Capital Market IT Systems Fail to Diffuse into the General Public?

Sapumal Ahangama(✉) and Danny Chiang Choon Poo

Department of Information Systems, School of Computing, National University of Singapore, 13 Computing Drive, Singapore 117417, Singapore
sapumal@comp.nus.edu.sg, dannypoo@nus.edu.sg

Abstract. Capital markets represent an important component of the economy of any country. Yet, it has been found that in a majority of countries, participation of the general public in capital markets is at a low level even with the availability of online trading platforms. In this study, we integrate constructs of diffusion of innovation, technology acceptance and trust models to form a context specific model in order to identify the factors influencing the general public in using online trading systems. Implications of a survey study carried out among a diverse group of investors are presented in this paper.

Keywords: Financial systems · Diffusion of innovation · Capital markets

1 Introduction

Capital markets signify an important component of the economy of any country. Economic research has shown that the performance of the capital markets is a direct indicator of a country's economic performance [1]. Further, these authors conclude that stock market development along with the banking sector development is robustly correlated with current and future rates of economic growth, capital accumulation and productivity improvements of a country. In addition, capital markets are a key source to raise capital for many firms ranging from medium to large scale organizations. A well-developed capital market may be able to offer different kinds of financial services to these organizations and may, therefore, provide a different kind of impetus to investment and growth compared to a developed banking system [2]. During the past few decades, a many-fold increase in market capitalization and market activity around the world was observed [3, 4], proving the importance of capital markets.

Owners of stocks in a capital market can either be individuals or institutions. As mentioned before, the individual participation in capital markets is a better indicator of the economic development in any country. Interesting results could be observed from a study conducted by a compilation across 70 countries to estimate the capital market participation as a proportion of the population [5]. These results show (Table 1) that there is a high diversity among countries and that the participation in developed countries is also at a relatively low level.

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Table 1. Country percentage of population participating in capital markets in several countries [5]

Country	Percentage of population participating in stock markets
Argentina	0.52
Australia	31.88
China	5.9
Ghana	1.5
India	2.00
Romania	0.05
Singapore	11.97
Spain	2.22
Sri Lanka	1.53
United States	21.2

Traditionally, a capital market operation is broker-centric and stock market floor is a centre of high activity with the process of placing orders. Individuals will have to place orders on the capital market through a stock market broker. But in the past few years, technology has evolved to a level where individual participants can directly place orders online, either using a computer or mobile devices rather than relying on stock brokers. Such online trading systems have enabled individuals to obtain real-time financial updates, other analytic services and to reduce time taken to place orders. Further and more importantly, the cost of placing orders has been reduced and the control of market participation is taken to the individual level [6]. These could be stated as the main goals of incorporation of such technology which have resulted in easy access to the public and higher participation among populations. However, the latter of the two has been least achieved in many countries as shown in Table 1.

A similar example to capital markets would be the traditional auction environments. The traditional auctioning setup was similar to in-person participation with an auctioneer in charge of the process. However, with the introduction of online auctions, many tend to purchase even common household items from such systems now. Further, it is stated that online auctions attracted billions of dollars over the past years with a 10 % monthly growth rate [7]. This shows that the innovation diffusion in this sector has been successful.

In contrast, it is evident that although many technological innovations have taken place in financial markets making the trading process simpler and easily accessible, the population penetration has been poorly achieved. The innovation diffusion in the sector has been hampered due to various reasons and that will be investigated in this study. As mentioned previously the degree of population penetration of online stock trading systems are very low. In this study, the adoption of such online stock trading systems is analyzed based on a modified diffusion of innovation (DOI) model with other suitable constructs. Hence the research questions of the study are as follows.

- RQ1: Are the DOI model constructs significant predictors of user adoption of online stock trading systems?
- RQ2: What other factors influence the user's adoption of online stock trading systems?

Considering the dearth of studies related to online stock market adoption with trust models, this study provides few contributions, namely, an extended conceptual model for online stock markets is introduced and the findings will be useful to the developers as well as to implementers in introducing these systems successfully. In subsequent, sections the theoretical background, conceptual model and data analysis will be presented elaborately.

2 Theoretical Background

Electronic commerce (e-commerce) is the process of "sharing of business information, maintaining business relationships, and conducting business transactions by means of telecommunications networks" [8]. Hence online stock trading too can be viewed as a form of e-commerce. Due to the popularity, adoption, innovation diffusion and various other concepts of e-commerce have been evaluated in detail in prior research. For example Internet Banking is a field of e-commerce which is subjected to in depth studies [9, 10]. Yet, the depth of studies with regard to online stock trading systems dealing with capital markets can be considered to be inadequate.

The innovation diffusion of information and communication technology with regard to stock brokering industry has been studied in the past [11]. In such a study it is said that the stock brokering firms openly adapt to new information and communication technologies in order to maintain competitiveness and to be responsive to market conditions. Further studies on broker decision on adoption and strategies to motivate brokers on online stock trading systems have been carried out in different country contexts [12, 13]. Although the main focus of this study is on retail investors in stock trading, the technological advances of brokers in facilitating the technology for stock traders should be noted.

On a perspective of the retail investor, few studies have been carried out in various country contexts to understand retail investor interest on adoption and intention to use the new technology [14, 15]. The studies are based mainly on the Technology Acceptance Model (TAM) and the decomposed Theory of Reasoned Action (TRA) and not on the view of adapting to new technologies.

Since much technological advancement has taken place in online stock trading platforms of retail investors, Diffusion of Innovation (DOI) presented by Rodgers (1995) is utilized in this study in order to understand the technological adoption by retail investors [16]. The DOI model has been popular among many information systems research in the past in studying new technology adoption [17]. In addition, due to the relation of online stock trading to e-commerce, factors from Technology Acceptance Model (TAM) and trust worthiness models are used for the analysis. Previous research has found that these models play a significant role in assessing the user acceptance in e-commerce applications [18–21]. However due to the complexities

of online stock trading process in contrast to common e-commerce scenarios such as online retailing, internet banking etc. more attention will be paid to make the model context specific with in-depth analysis of the stock trading process. The framework and guidelines proposed by Hong et al. will be utilized to generate context specific information systems research [22]. Hence it is intended to come up with a relevant and parsimonious model using the models of Diffusion of Innovation, Technology Acceptance and web trust.

2.1 Diffusion of Innovation (DOI)

According to the Diffusion of Innovations (DOI) theory, an innovation is "an idea, practice, or object that is perceived as new by an individual or other units of adoption" [23]. Further, the process of innovation diffusion can be explained as the "process by which an innovation is communicated through certain channels over time among the members of a social system" [16]. Based on the model, the rate of diffusion of an innovation is dependent on the factors such as relative advantage, compatibility, complexity, trialability and observability. Based on the model,

- Relative advantage: the degree to which an innovation is perceived as better than the idea it supersedes.
- Compatibility: the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.
- Complexity: the degree to which an innovation is perceived as difficult to understand and use.
- Trialability: the degree to which an innovation may be experimented with on a limited basis.
- Observability: the degree to which the results of an innovation are visible to others.

Apart from complexity, while the other constructs are generally positively correlated with rate of adoption, complexity is generally negatively correlated with rate of adoption [16]. However, according to published literature, compatibility, complexity and relative advantage are the most important antecedents to the adoption of innovations in the information systems domain [24]. Yet in this study trialability is retained, as consultation with stock brokers insisted that experimentation on a limited bias is an important factor for adoption by retail investors and also that such systems commonly exist.

In addition, Moore and Benbasat (1991) present two further constructs; image and voluntariness of use which is beyond Rodgers' classification [25]. In this study it is stated that image as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system". Although originally it was argued that image is an aspect of relative advantage, research has shown that image can be considered to be adequately different from relative advantage [24]. Given the popularity of stock trading within the social systems, image is included in our analysis. However voluntariness of use is not considered as a separate construct since the usage of online stock trading systems is an individual choice and hence would not show a significant variation [17].

2.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) [26] is a widely used model to understand the user acceptance of technologies. Although TAM model was introduced in the organizational context to understand software technology acceptance by employees, it has been widely tested in scenarios where e-commerce adoption was tested which is very much similar to online stock trading adoption [18–21]. According to TAM model, perceived usefulness (PU) and perceived ease of use (PEOU) influence the individual attitude of using a system. This in turn drives the behavioral intention to use. However TAM also provides a suitable theoretical foundation on intention to use based on ease of use and usefulness of the innovation [26]. Further complexity construct of DOI is similar to the PEOU construct from TAM in reverse direction [17].

2.3 Trust

Trustworthiness of a system may impact system adoption. For example, it has been shown that trustworthiness plays a significant role of citizens adapting to e-governance systems [17]. The importance of trust in e-commerce applications is well illustrated in previous research [27]. The study develops measures of trust suited for e-commerce scenarios based on previous studies and concludes that trust has many dimensions. The study states that "e-commerce consumers gauge web vendors not in broad, sweeping terms, but in terms of specific attributes". Further the study states four constructs, where one construct is with regard to institution based trust. It is stated that "Institution-based trust comes from sociology, which deals with the structures (e.g., legal protections) that make an environment feel trustworthy". Similar to e-governance study [17], as online stock trading is dealing with confidential information and electronic financial transactions, trust will play a key role and trust placed on the internet and trading systems are considered in the model.

3 Research Model and Hypotheses

The integrated research model of diffusion of innovation characteristics, technology acceptance and trustworthiness constructs is shown in Fig. 1. The hypotheses developed based on the background and theory presented in the previous section is given below.

- HYPOTHESIS 1 (H1): Relative advantage has a positive effect on the intention to use an online stock trading system.
- HYPOTHESIS 2 (H2): Compatibility has a positive effect on the intention to use an online stock trading system.
- HYPOTHESIS 3 (H3): Trialability has a positive effect on the intention to use an online stock trading system.
- HYPOTHESIS 4 (H4): Image has a positive effect on the intention to use an online stock trading system.

- HYPOTHESIS 5 (H5): Perceived usefulness has a positive effect on the intention to use an online stock trading system.
- HYPOTHESIS 6 (H6): Ease of use has a positive effect on the intention to use an online stock trading system.
- HYPOTHESIS 7 (H7): Trust of internet has a positive effect on the intention to use an online stock trading system.
- HYPOTHESIS 8 (H8): Trust of trading systems has a positive effect on the intention to use an online stock trading system.

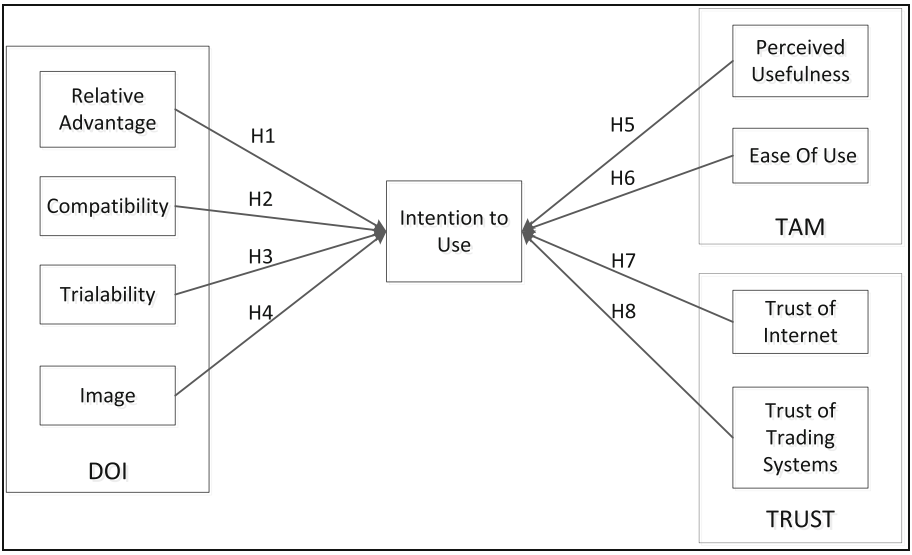

Fig. 1. Research model

4 Research Methodology

This study was carried out through a survey.[1] Sri Lanka was selected as the base country of study as the online stock trading penetration was reported to be at a very low level in Sri Lanka [5], although the country processed a stable and advanced stock trading platform [28, 29]. The survey questionnaires were distributed among employees at different levels of several organizations. However, the sample was selected such that the participants had prior investment experience and investment knowledge, without considering whether they have or have not invested in stock trading, engaged in online stock trading.

[1] The survey questionnaire is not attached to this paper due to the page limitations. Please contact authors should it be required.

4.1 Operationalization of Constructs

In order to develop survey instruments, previously validated scales were used. To measure innovation diffusion characteristics, items were adapted from Moore and Benbasat [25]. The scales for perceived usefulness and ease of use were adapted from Gefen and Straub [18]. Items for intention to use and items for trustworthiness on internet and stock trading systems were adapted from Carter and Belanger (2005) after modifying to suite the context [17].

A seven-point Likert scale ranging from 1 (strongly-disagree) to 7 (strongly-agree) was used in the questionnaire. Review of the survey questions were carried out with IS researchers prior to the actual survey, in order to validate the appropriateness of the questions. Further a separate pilot study was conducted among a sample of 30 suitable individuals in order to improve the validity and reliability of the instruments.

4.2 Data Collection

As mentioned previously individuals with background of investment were selected as samples for the survey study. In order to collect responses, online and paper based survey forms were used. Paper based survey was used for data collection carried out at organizations. However the participation of the survey was on a voluntary basis.

A total of 131 valid responses were collected. The sample had a range of 18 to 75 years of age (mean of 30.77 and standard deviation of 10.741). Other descriptive statistics are given in Table 2. As a general rule, in order to carry out a reliable survey the minimum number of responses has to be 10 times the number of constructs [30]. Since the study includes only 9 constructs, the sample size of 131 is adequate.

Table 2. Descriptive statistics of the sample

Sample Profile		Frequency	Percentage
Gender	Male	94	71.8 %
	Female	37	28.2 %
Investment Experience	Less than 1 year	24	18.3 %
	Less than 3 years	34	26.0 %
	Less than 5 years	24	18.3 %
	Less than 10 years	19	14.5 %
	More than 10 years	30	22.9 %
Stock market investment	Yes	66	50.4 %
	No	65	49.6 %
Use of online stock trading systems	Yes	44	33.6 %
	No	20	15.3 %
	Not applicable	67	51.1 %

5 Analysis and Results

The data analysis was carried out using partial least squares (PLS), a structural equation modelling technique with SmartPLS software package. PLS was selected to carry out the analysis as it enables to access the measurement model (relationship between items and constructs) within the context of the structural model (relationship among constructs) and also as it does not require large sample sizes of data [30]. Validity of the measurement instruments and results of hypothesis testing are presented below.

5.1 Instrument Validation

In order to demonstrate the construct validity, the convergent validity (the extent to which two or more items measured the same construct) and discriminant validity (degree to which items that measure different constructs differed) tests were carried out.

The convergent validity of the constructs was assessed using item reliability, composite reliability (CR) and average variance extracted (AVE). The generally accepted thresholds for item loading for constructs, CR and AVE are 0.5, 0.7 and 0.5 respectively [30]. The minimum item loading recorded was 0.81. The values of CR and AVE can be found in Table 3, where the values are within the accepted thresholds. Thus we concluded that the convergent validity is satisfactory.

The discriminant validity of constructs is satisfied if AVE for each construct is greater than its correlation with other constructs. This is shown in Table 3. Based on the results discriminant validity is also supported.

Table 3. Construct validity measures

	CT	IM	EU	PU	RA	TR	TRUST I	TRUST S	USEI	CR	AVE
CT	**0.93**									0.95	0.87
IM	0.25	**0.90**								0.93	0.82
EU	0.69	0.32	**0.88**							0.93	0.78
PU	0.72	0.25	0.75	**0.89**						0.94	0.79
RA	0.81	0.27	0.64	0.82	**0.90**					0.94	0.81
TR	0.39	0.22	0.36	0.49	0.49	**0.91**				0.91	0.84
TRUST I	0.48	0.25	0.45	0.42	0.44	0.15	**0.92**			0.94	0.84
TRUST S	0.62	0.23	0.62	0.57	0.58	0.23	0.71	**0.91**		0.95	0.83
USEI	0.82	0.19	0.73	0.82	0.82	0.4	0.53	0.64	**0.83**	0.91	0.69

Notes. Leading diagonal shows the squared root of AVE of each construct, CT = compatibility, IM = image, EU = ease of use, USEI = intention, PU = perceived usefulness, RA = relative advantage, TR = trialability, TRUST I = trust of internet, TRUST S = trust of trading systems

5.2 Hypotheses Testing

After validating the measurement model PLS was used to carry out the hypotheses testing. Demographic variables age and gender was used as control in the controls of the model.

Figure 2 shows the path coefficients of the significant results in the model. Relative advantage, compatibility, image, ease of use, perceived usefulness and trust of internet indicate a significant effect on the intention to use the model for analytics. However trialability and trust of trading systems doesn't indicate a significant relationship. In addition, the direction of relationship between image and intention to use is negative. Hence hypotheses H3, H4 and H8 are not supported. All the other significant relationships indicate a positive influence and as such H1, H2, H5, H6 and H7 are supported.

The explanatory power (R2) is 0.83 and it is above the threshold of 0.10 and hence is an indication of a substantive explanation power [30].

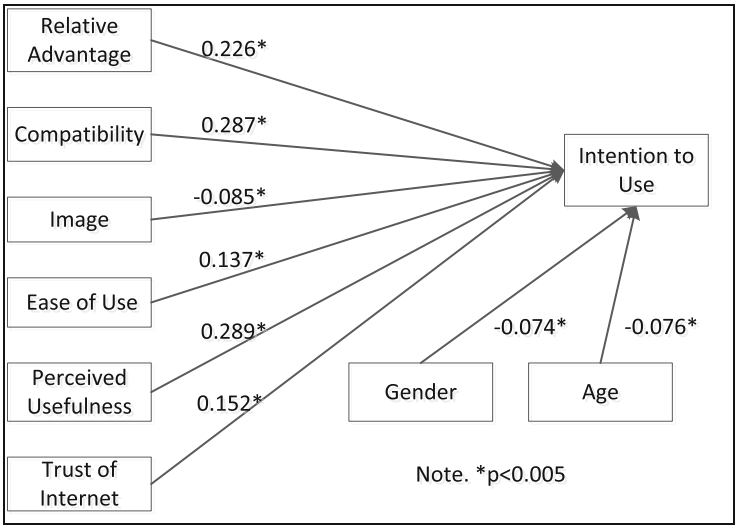

Fig. 2. Results of hypotheses testing

6 Discussion

Several important relationships were established from this study especially with DOI constructs relative advantage, compatibility and image being significant. It was found that relative advantage and compatibility are important factors affecting the intention to use online stock trading systems. Hence designers of online stock trading systems should design the system such that the online stock trading systems provide maximum advantage over traditional and other investment methods currently popular among investors. It is essential to explore all options that can be achieved from an online

system. Further the significant positive relationship of compatibility shows that online stock trading systems should be designed for investors in such a form that they are compatible with their existing investment methods. For example for a stock market investor using traditional methods to place an order, the system should provide a compatible experience. An investor using other online investment systems would expect the online trading systems to be consistent with the existing systems.

However it was found that relationships between image and trialability were not as expected. It could be that since stock trading is a commonly found investment option for investors, use of an online trading platform will not result in added social status and image. In addition investors may not invest with the intention of improving their social status but merely to increase their income. Although experts in the industry viewed trialability as an important factor, since such a system provides only mock trading options and as it cannot be compared to a real transaction, the importance to investors may be low.

Significant positive relationship between ease of use and intention to use indicates that investor intention to use an online stock trading platform increase if the system is easy to use and is not complex. An online stock trading system should be easy to navigate, information should be well organized and presented as well as should enable to carry out transactions effortlessly. If such ease of use features are not available the intention of investors to adopt the technology would decrease. The significant positive relationship of perceived usefulness would provide a similar explanation to that of relative advantage.

Another important observation found was the significance of trust on internet. Since online stock trading systems deal with financial transactions reliability and security of the internet is an important aspect. Investors who perceive the reliability and security aspects of the internet to be low will be less likely to adopt online transactions. Another important observation made was that many investors indicated concerns on importance of reliability and security aspects of the internet in order to adapt to online stock trading systems.

7 Conclusion

As theoretical implications, this study presents a model with the extension of DOI, TAM and trust models to online stock markets adoption by introducing new parameters to consider. The study is carried out with a sample of investors with ample experience and knowledge on financial investments, as well as actual users of online stock trading systems from a country with low online stock trading penetration. Further, the sample was diverse in age, experience and financial ability. Hence the results of the study can be considered as highly valid in the context of online stock trading.

As practical contribution, we proved that relative advantage, compatibility, ease of use and trust are important constructs of online stock trading systems. The results can be used in the process of designing online stock trading systems in future leading to more user adoption of such systems.

Several limitations were encountered in carrying out this study. Firstly the limited sample size of 131 individuals should be pointed out as if a larger sample size was

obtained, the results would have been more robust. In addition, during the study, no consideration was paid to mobility in accessing the online trading system and the study was conducted in general to all available online trading systems. Since mobile access of online stock trading systems would provide more interesting results, it is open for future research.

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